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The Effects of a Commons Simulation and Fines on a Generalization Test

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THE EFFECTS OF A COMMONS SIMULATION AND FINES ON A GENERALIZATION TEST

by

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Bill Boyle

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ABSTRACT

The Effects of a Commons Simulation and Fines on a Generalization Test

by

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The present study investigated the effect of a commons simulation and fines on a generalization test that incorporated several features important in the real world. Two hundred and seventy-five volunteer college students in groups of seven participated in this study. Approximately one-half received exposure to the commons simulation and one-half did not. One-half of the groups in each treatment level received two posttests with a fine option available and the other one-half received two posttests without this option. The two posttests differed in that one was played with a large unknown referent group and the other was played with the immediate group of seven. The results showed that some generalization from the commons simulation to the large posttest does occur. However, subjects in the large group do not cooperate (act in the common group interest) more or defect (act in the individual interest) less, but become more cautious as a result of the simulation exposure and withdraw from the commons when playing with a large and unknown referent group. (97 pages)

CHAPTER I

INTRODUCTION

In the last decade, considerable attention has been devoted to the study of laboratory commons dilemmas (Dawes, 1980). Though several variables have been found which increase cooperation in these simulations, there are several shortcomings with this research. For example, McTavish (1977) pointed out in her critical review of the literature that behavior learned in a simulation does not generalize to real world referents. The few attempts to demonstrate the generality of laboratory findings to external settings have relied upon questionnaire and other self-report data. Though some correspondence may be found between cooperative behavior in the simulation environment and self-report measures, it is not clear whether subjects would do as they say they would in the face of real world dilemmas. Consequently, the measurement of the effects of laboratory simulations are dubious at best and have provided little evidence that players will behave responsibly (cooperatively) in the face of real world dilemmas. Thus, one purpose of the present study was to test the effects of playing a repeated trials Commons Dilemma Game (Powers, Duus, & Norton, 1980b) by measuring what players will do in a test that is different from the simulation setting.

A further major purpose of the present study was to determine if a variable effective in the laboratory setting, i.e., fines, will generalize to another setting in which the group is large and unknown, thus, assessing the effectiveness and validity of this variable. Fines have been examined in the laboratory setting and have been found to be effective in producing cooperation and preventing defection or exploitation in the commons simulation itself (Powers et al., 1980b). In almost all the studies examining the effect of fines on behavior, fines have been found to reduce resource exploitation or increase cooperation within the simulation exercise.

CHAPTER II

REVIEW OF THE LITERATURE

This chapter will review the literature related to the commons dilemma problem. Specifically, this review will define the commons problem; review the suggestions made by researchers for engaging in useful research in this area; present a reinforcement analysis of commons dilemmas; and review the relevant research using commons simulations to investigate variables sufficient to alleviate these simulated commons problems.

Defining the Commons

The major impetus for research investigating commons dilemmas, such as pollution and resource depletion, was Garrett Hardin's article, "The Tragedy of the Commons" (1968). In this article he defined a commons as a resource that belongs to no one in particular but is accessible to everyone to use. The tragedy of the commons is illustrated in this manner: Assume that there is a township that has a pasture to graze cattle that is available for use by all the ranchers. If the ranchers use the resource within its carrying capacity, the resource will be productive and yield high quality cattle to all the ranchers who use the pasture. The problem of the commons begins when at least one rancher decides to increase personal gain by adding more cattle to the pasture. The action of adding additional cattle encourages other ranchers to do the same and soon the pasture becomes unable to optimally support the cattle. Further, each rancher enters a position in which he can cut his losses by adding more cattle, while the other ranchers share the loss equally in proportion to the amount of cattle each has grazing in the pasture. Thus, the pasture is inevitably destroyed.

Defining a Course for Research

The main conclusion of Hardin's work has been to refocus solutions to commons dilemma problems. Traditionally, scientists have focused on technological solutions to mankind's rapid depletion of some of the world's resources-- they have said that we will develop the scientific machinery necessary to solve the problem of resource overuse and depletion. For example, it has been said that science will develop the means to mine or drill deeper into the earth to extract precious minerals that are in short supply, or science will develop better methods of agriculture for arid climates to feed the malnourished people of the world. Hardin argued that these solutions are not pending, that these are a class of problems to which no long range technological solutions are possible. Hardin went on to suggest that we must find other solutions to the problem, namely political solutions.

Crowe (1969) agrees with the seriousness of the commons problem but questions the usefulness of a political solution. Political solutions rest upon three assumptions: 1) that a weighing system can be developed that will equate incommensurables; 2) that a useful system of mutual coercion can be developed that will provide the greatest good for the greatest number; and 3) that an administrative system can be developed to prevent destruction of the commons. Crowe argued that science can be helpful. Both the natural and the social sciences can be useful in alleviating commons problems by rewarding those people who no longer exploit the commons and by monitoring the commons and providing educational information for ". . . corrective feedback . . ." (p. 1107).

In an attempt to develop a focal point for research, Boniecki (1977) suggested that scientists answer the question, "Is man interested in his future?" (p. 59). By answering this question, Boniecki thinks personkind will then act in ways that are helpful to preserve humanity. In his article, Boniecki proposed an international research program that will attempt to bring about solutions to resource depletion and overuse problems and stresses that this program should focus on the developed world. The goal is to change the wasteful style of life of the developed countries.

Stern (1978), in response to Boniecki's article, proposed that researchers study the behavior of people in a commons across all cultures and societies. Specifically, researchers should examine within each society ". . . the conditions under which people manage the resource wisely, with the focusing primarily on attitudes about the future" (p. 156). He proposed three directions for this research: 1) researchers need to identify the values that are consistent with ". . . maintenance of commons resources for the future" (p. 156); 2) researchers must identify the groups and institutions that have or will maintain commons resources; 3) researchers need to learn more about the mechanisms useful in establishing institutions which will increase our awareness of the future.

A Reinforcement Analysis of Commons Dilemmas

Platt (1973) presented a reinforcement analysis of commons dilemmas and defined them as social traps. A social trap is: ". . . a situation in society . . . where members or organizations or whole societies get themselves started in some direction or some set of relationships that later prove to be unpleasant or lethal and that they see no easy way out of or to avoid" (p. 641). Platt's behavioral analysis of commons dilemmas uses Skinner's three-term formulation of stimulus-behavior-reinforcement. That is, some salient aspect of the environment (stimulus) impinges upon an organism causing a response (behavior) which is then followed by a consequence (reinforcer or punisher). The notion of a trap also includes a time component and dual consequences, short-term and long-term consequences for a behavior. Thus, a trap occurs when in the presence of a stimulus, an organisn emits a behavior that generates highly reinforcing immediate consequences and punishing delayed consequences. Because of the immediacy of the short range consequence, the behavior is reinforced immediately after occurring, while its punishing aspects occur after a period of time in which many other behaviors may have intervened. A good example of a trap is whaling in the 20th century. Initially, whalers hunted a few whales. However, as whaling became quite profitable, whalers began to hunt more and more whales without regard for the large number that were being killed. More money was put into more modern equipment to maintain or increase whale catches as the resource began to dwindle. Now, with the resource at very low levels many countries have faced the reality that whaling has become unprofitable because the resource is near exhaustion. However, several countries have not yet accepted this fact and will at sometime in the near future have to face the reality that whaling will no longer be profitable either because resources are too low or all the whales have been killed.

Characteristics of a Commons Simulation

Several games have been developed by researchers to investigate behavior in a commons dilemma. The Nuts Game was developed by Edney (1979) and allows subjects to pick bolt type nuts which are equated with a resource (like money or class points) from a bowl. Dawes (1973) presents another commons dilemma simulation which is a multiple trial game in which individual subjects can make one of two choices: to defect (individualistic, selfish play) or cooperate (cooperative, group oriented play). Another game was developed by Powers, Duus, and Norton (1980b) which allows subjects to make one of five choices on each trial of a multiple trial game. Subjects in a group can cooperate, defect, withdraw (play for low salary that affects no other players), help cooperators (add points to cooperative players scores), or fine (impose a fine on defectors) defectors. In all these games the experimenter is free to vary a number of independent variables, for example, communication, information, resource replenishment, resource value, and size of groups. The last game presented by Powers et al. (1980b) also allows the experimenter to manipulate the availability of specific choices, the values of individual choices, and the effect of the choices in relation to each other. These game properties allow the experimenter to examine more of the variables that might be helpful in solving commons problems in the real world.

In his article, Stern (1978) outlined several features that he considered necessary for a commons simulation. One, individuals should be able to make choices that are independent of the immediate effects of the other players in the simulation. Two, the simulation should allow for intragroup dynamics, specifically, players should be allowed to communicate among each other. Three, the simulation resource should be dynamic, that is, the state of the resource should be subject to change as a function of player choices. If individuals attempt to take too much of the resource, the resource should deplete with the consequence of less, or zero, resource for subsequent play. Four, a simulation should allow for the play of inter-group actions, that is, the play for other agencies to affect group outcomes.

Relevant Research

Many reviews of the literature have been written that directly relate to the commons problem. Often these reviews deal extensively with conservation and consumption behavior, commons dilemmas, and multiple-n prisoner dilemmas (Dawes, 1980; Edney, 1980; Edney & Harper, 1978b: Linder, 1982; Norton & Powers, 1981; Shippee, 1980). In general these reviews define the problem of the commons, elaborate on theoretical explanations, review methodological approaches of the study of commons dilemmas, expound upon variables sufficient to alleviate the commons problem, and propose directions for future research. The review of the research that follows will outline the important research in the area of commons simulations, present the results of these studies, and summarize the findings to date.

Stern (1976) in a carpooling simulation assigned subjects in groups of four to one of the cells of a 2 X 2 X 3 factorial design. One independent variable manipulated was gasoline prices or gas rationing coupons. Another independent variable was the amount of information available about rationing and pricing changes that occurred during the game. Subjects were told that rationing or pricing would change with time without further explanation or were given further information about the changes and when they would occur. The final independent variable was the degree of information about the commons. Subjects were given either a) no information, b) an effective strategy that would reduce costs for the driver, or c) messages every 3 minutes reminding subjects of the long range consequences of their behavior. In the simulation, subjects made one of three choices: to drive alone, to drive in a carpool, or to ride in the carpool. The dependent measure was the amount of carpooling done by the subjects. The results showed that increasing prices was more effective in maintaining the resource than rationing. Also, detailed information about pricing and rationing schedules influenced people to car pool more often. An analysis of sex differences produced no significant finding.

Brechner (1977) investigated the effects of communication and resource size on resource management. Subjects in groups of three were assigned to one of the cells of a 2 X 2 factorial design. The two levels of communication were open communication in which subjects could communicate freely and no communication. Resource size included one resource being twice as large as the other. Subjects responded on an fixed ratio 10 schedule of reinforcement for a point. Subjects also had to wait 6, 12, 18, or 24 seconds before they could respond for an additional point (differential reinforcement of low rates of responding schedule of reinforcement). Subjects had to wait at the longer intervals if the resource was more depleted. The resource pool replenished itself every 2, 4, 6, or 8 seconds depending upon the level of resource remaining. The pool doubled in size at replenishment time with the maximum number of points equal to the number available at the beginning of the game. The dependent measure in this experiment was the number of points returned to the resource pool. The results showed a significant effect for both pool size and communication. Subjects in the larger pool size and the communication groups returned more points to the resource.

Edney and Harper (1978c) exposed college students to a commons dilemma simulation in which they could earn points for credit. Subjects in groups of three were assigned to one of four groups: simulation only; simulation plus information about trap characteristics; simulation plus a strategy for avoiding traps and earning a large number of points; and simulation plus verbal communication at any time. Subjects played 12 rounds of the game and could earn zero to three points on a given round. The resource started with 15 points and was doubled at the end of each round but was restricted to a maximum of 15 points at any given time. Five dependent variables were used: 1) the number of games in which traps were avoided; 2) the number of points obtained per group; 3) the number of rounds played before the resource was exhausted; 4) the number of points returned to the resource; and 5) the range of points earned by individuals in each group. The results of this study showed that the free communication group did significantly better than the other groups on all measures of resource maintenance. In addition, the information group did significantly better than both the simulation only and the strategy group on number of points obtained, rounds played, and pool replenishments.

In yet another study, Edney and Harper (1978a) investigated the effects of responsibility and communication in a commons simulation in a 2 X 2 factorial design. The two levels of responsibility were the presence or absence of a volunteer leader. The two levels of communication were no communication and communication at any time. In groups of three, subjects were exposed to a commons simulation in which they could earn 0, 1, 2, or 3 points on a given trial as long as the resource contained points. In addition, subjects could choose to double the resource by holding up an 'X' card and skipping two trials. The pool limit was 15 points and automatically doubled every two trials. The five dependent variables were: number of 'X' cards played, total points earned, number of trials played, and the number of points replenished. The results showed that on all dependent measures the communication group did significantly better than the no communication group. Leadership produced no significant results though leaders themselves played more 'X' cards than nonleaders.

Shippee (1978) investigated the effects of leadership and group participation on resource management in a simulated commons dilemma. The three levels of leadership were no leader, a leader randomly chosen by the experimenter, or a group elected leader. The three levels of participation were individual, majority, or unanimous ability to restrict the resource, that is, in the individual condition one person could control access to the resource; in the majority condition, a majority of subjects could agree to restrict the resource; and in the unanimous condition all subjects had to agree to restrict the resource. A "trailing control group", that received none of the experimental conditions, was included as part of the study. Subjects were exposed to a commons simulation in which they removed nuts from a bowl (equated with class points) one at a time. The resource was doubled every 15 seconds and never exceeded its starting size. The dependent measures were duration of resource, number of units replenished, amount of resource accumulated, rate of resource removal, and the proportion of groups in each condition that depleted the resource. A second set of dependent measures were gathered to assess the processes used by the group. In general, the results of this study showed that elected leadership, when combined with high participation, produced significantly better resource management than the other experimental groups and the control group.

In another study, Talarowski (1977) researched the effect of moralizing and positive incentives in a decomposed commons game. The game was decomposed in that the amount cooperators and defectors earned was less on some subsequent trials. The two levels of incentive used were high incentive in which defectors always earned \$8.00 more than cooperators and low incentive in which defectors earned only \$5.00 more than cooperators. The two levels of moralizing were information about the mechanics of the game and information plus an explanation of the benefits and the risks of the game (moralizing). The dependent measures were the number of defections and the predictions subjects made about defection. The results of this study showed a significant effect of both incentive and moralizing. Specifically, the results indicate that groups given an explanation of the game benefits and risks defected much less than the other groups. Also, the groups with the smaller payoff differential between cooperators and defectors defected much less than the other groups. There was also a significant effect for decomposition between the trials.

Kelley and Grzelak (1972) investigated the effect of manipulating the degree of individual and common interest. The two levels of individual interest were low and high differences between the payoff scores of cooperators and defectors on a given trial. The two levels of common interest were small and large increases in the payoff scores of both cooperators and defectors. That is, the scores of both cooperators and defectors were increased as the number of cooperators increased. In groups of five, subjects played four multiple trial games, one in each condition. On a given trial, subjects made one of two choices, to cooperate or to defect. The dependent measure was the number of cooperative responses made by each group for the first 10 trials and the last 10 trials. Subjects were also given a questionnaire to access their perceptions about the game. A comparison of the first 10 trials with the last 10 trials within each group showed that the high individual interest groups (high disparity in amount of resource earned between cooperators and defectors) declined significantly in the number of cooperative choices made while cooperative choices rose in the low individual interest group. An analysis of a questionnaire showed that the cooperative subjects appeared to be more aware of their ability to control the game.

Cass (1975) examined the effects of information and territoriality on the play of subjects in a simulated commons dilemma composed of four person groups. Subjects in the information condition were either given information about the status of the resource at any time or given no information. Subjects in the territoriality condition were assigned to three of 12 resource territories from which they could draw points while subjects in the other condition could draw points from any of the 12 resource territories. Subjects could draw points at any time from the resource. Each territory of the resource started with 4 points and was replenished by doubling to a maximum of 4 points every 3 minutes. When a given territory was exhausted (reached zero) it was not replenished. The game was played until all points (territories) were exhausted or until the fifth replenishment. Subjects were also administered a questionnaire after the exercise which attempted to assess subject beliefs, thoughts, and attitudes about the game. The three dependent measures used to assess the game were points remaining in the pool, total number of points replenished to the pool, and total number of points obtained from the pool. The results of this study indicated that there were significant results for both territoriality and information across all of the dependent variables. The groups given information and assigned to individual territories did significantly better at managing the commons resource.

Rubenstein, Watze, Doktor, and Dana (1975) studied the effect of two incentive schemes on behavior in a commons dilemma game. The two types of incentive were individuals keeping the points they earned or individuals sharing their points equally with the other members of the group. Another variable studied was the state of the resource at the beginning of the game, either full or half full. High school students in groups of five were exposed to a commons simulation card game. Subjects were dealt seven cards from a deck initially containing either half blue cards or all blue cards. If a player was dealt 5 blue cards, the player earned points. However, one of the blue cards a player was dealt was converted to red for the next trial. The player could circumvent this process by paying to stop the change or paying twice as much to add a blue card to the deck for the next round. The dependent measure was the amount of points spent by the group to maintain the resource. The results showed that groups beginning with the all blue card groups spent significantly less points to maintain the resource. Also, groups in the condition that shared points spent more points to maintain the resource.

In their research, Jerdee and Rosen (1974) examined the effects of communication and the visibility of play in another simulated commons dilemma. The two levels of communication were low communication in which subjects were not allowed to communicate and high communication in which subjects could conference after each trial. Subjects in the low visibility groups could only see their own play on each trial while subjects in the high visibility condition could see every player's play. In the game, subjects made bids for a company with the goal of making a profit for the company. One kind of bid emphasized maximum profit to the company at the expense of the rest of the industry. The other kind of bid produced less profit for the company and was good for the industry as a whole. Ten trials were played but only the last five were analyzed. The dependent variable was the number of each kind of bid made by the groups. The results of this study showed that groups allowed to communicate made twice as many bids that were good for the industry as a whole than the no communication groups. There was no effect for visibility.

In a study that examined the generality of a commons dilemma game, Powers and Boyle (1983) exposed subjects to a 2 X 2 X 2 design that investigated communication, information, and fines. Subjects in the no communication group were not allowed to conference; those in the communication group were allowed to have conferences every five trials after the 25th trial if a majority of players voted to do so. There were also two levels of fines: in one group players did not have the option to fine defectors while in the other condition players could fine defectors. The two levels of information were full information in which subjects were given a real world analogy relating fish and points and were told that defection would deplete the resource. The no information group was given no information about the game beyond the mechanics of play. All players played 50-75 trials of the commons dilemma game and could make one of five choices: cooperate, defect, withdraw, help cooperators, or fine defectors. After the subjects played the commons simulation, they were given a test with either three or four choices. The fine group had the fine option available, the no fine group did not. Posttests allowed subjects an opportunity to earn a large number of points on one trial. The results of this study showed that subjects in the fine and information conditions defected significantly less than the other groups on the generalization test. Within the no fine group, those groups allowed to communicate showed significantly more cooperation than the groups not allowed to communicate. Data were analyzed for differences in the group size (no statistics reported) but none were found.

In their study, Dawes, McTavish, and Shaklee (1977) used a 2 X 4 factorial design to investigate the effects of four levels of communication and losing or not losing money in a simulated commons dilemma. The four levels of communication were: 1) discussion of the commons before the play of each trial; 2) discussion prior to each play plus a non-binding vote prior to each trial; 3) social communication with no discussion about the game; and 4) no communication plus a work task unrelated to the game. The loss group was given knowledge that they could lose money while playing this game while the no loss group was assured that they would not lose money playing this game. On each trial subjects could choose to cooperate or to defect. Cooperators received \$2.50 minus \$1.50 for each person who defected. Defectors received \$12.00 minus \$1.50 for each person who defected. Subjects played in groups of five to eight people. The dependent measures used were the amount of defection and subjects' predictions of the play of others. The results showed that the subjects in the commons discussion group defected significantly less than the no communication and the irrelevant communication groups. There were no differences as a function of the possibility of losing money playing the game. Other results of this study indicated that people in the no communication condition and people who defect predict significantly more defection. Also, groups which could communicate were better predictors of the play of others. Data were also analyzed for sex and group size but differences were not statistically significant.

Powers, Duus, and Norton (1980a) examined the effects of communication and player imposed fines and rewards. At various points in a commons game, subjects were allowed to communicate during conferences available every 5 trials. In addition, the choices the subjects could make varied during the game. An altruistic choice (giving cooperative players points) and a policing choice (allowing subjects to fine defectors) were introduced at different times in the game. The dependent variable was the frequency the groups played each of the choices available in the game. The results were not statistically analyzed but the following trends were reported. When subjects could choose a withdrawal response or fine defectors, defection decreased. In several of the communication groups, the introduction of communication decreased defection. In a generalization test presented after the game, the level of cooperation increased as a function of the number of times the individual had played the game.

Powers, Duus, and Norton (1979) have summarized the play of subjects exposed to the Commons Game. While playing this game subjects as a general rule opted for defection. When a withdrawal or a policing response was introduced to the game, more cooperation and less defection occurred even though the withdrawal and policing responses were not played very much.

In another study, Smith, Powers, and Boyle (1984) examined the effects of group size (six vs eighteen) on the choices of players in the Commons Dilemma Game. Subjects could chose one of five colors indicating choices to cooperate, defect, withdraw, help cooperators, or fine defectors over a series of fifty trials. The dependent variables were the percentage of color choices each group made for the first 25 trials versus the last 25 trials. The results of the study showed that groups of six players defected significantly more than the groups of 18 players. The reason for this is not known and is currently being investigated. In addition, both sized groups improved in their play from the first 25 trials to the last 25 trials. Specifically, the groups cooperated more, defected less, fined defectors less, and helped cooperators more in the last 25 trials.

Naturalistic Studies

In a naturalistic study, Acheson (1975) examined the effect of territoriality on lobster beds off the coast of Maine. He examined two kinds of lobster territories: "nucleated" and "perimeter defended" territories. These two kinds of territories differ in the degree to which exclusively maintained fishing rights are maintained through local (not legal) custom. Perimeter defended areas are territories which lie close to the harbors from which the lobstermen operate and which through custom have strict boundaries for individual use. Nucleated areas lie farther from the harbors and have no precisely defined areas of ownership, all lobstermen from different areas may fish with impunity. Data were obtained over three seasons on several dependent measures: catch per unit of effort, number of lobsters caught, lobster caught per trap, pounds of lobster per trap, price per lobster, and fisherman income. The results of this descriptive analysis indicated that fisherman in the nucleated areas showed many of the problems of an overused commons resource, that is, on all the dependent measures fisherman in nucleated areas had poorer outcomes than the fisherman from perimeter defended areas.

McHugh (1977) analyzed the history of whaling and illustrated the tragedy of the commons by outlining the decline of the world's whale stocks through unrestricted killing of whales. In the 20th century, the amount of whale oil harvested was at an all time high, whaling fleets were at their largest, and 18 countries were whaling. As whale stocks declined noticeably in size, companies developed more technological means to catch whales--i.e. sonar, helicopters, factory ships, etc. As whale stocks declined to severely low levels, whaling companies attempted to set quotas, but often they could not agree. Each company wanted a larger part of any quota. As stocks depreciated even more, countries began to set quotas for specific whales and oceans and in 1946 the International Whaling Commission was formed. The International Whaling Commission has not been very effective and was neutralized by countries walking out in disagreement with lower quotas. Additionally, it often set quotas that were too high. It was not until the mid 1960's that more reasonable quotas were established that allowed some whale stocks to begin recuperating. Today, although many countries have realized the importance of the resource and have banned whaling altogether some countries continue to hunt with Japan and the USSR consuming 85%

of the world's catch.

Research Summary

In summary, the results of previous studies have shown that many variables are effective in controlling resource depletion and the behavior of subjects within laboratory commons simulations. Variables that have been effective are communication, information, responsibility, group participation, possibility of losing money, resource size, and fines. In general, these variables were effective in remediating a simulated resource depletion problem.

Communication within the simulation setting has been the most examined variable that has proved effective in controlling commons problems. Several forms of communication within a variety of experimental analogs have been effective. A few studies have allowed communication at any time or before each trial of the simulation (Brechner, 1977; Dawes et al., 1977; Edney & Harper, 1978a, 1978c; Jerdee & Rosen, 1974). Other studies have controlled the amount of communication so that it is available every 5 trials (Powers et al., 1980a) and only if a majority of subjects voted to communicate (Powers & Boyle, 1983; Smith et al., 1984). In all studies in which communication was allowed, subjects managed the resource better than subjects not allowed to communicate.

Information is another variable that has been examined quite extensively in commons simulations. The research has indicated that the more specific the information subjects are given about the nature of the commons simulation, the more effective their strategies are in remedying the commons problem. Edney and Harper (1978c) showed that the more information subjects had about the trap characteristics of a commons simulation, the better the groups managed the resource. They also showed that general strategy suggestions were ineffective. Powers and Boyle (1983) showed that information about the mechanics of the game alone was not effective in bringing about generalization to a posttest. Subjects had to be informed of how the changes will affect them, that is, what consequences will occur as a result of their play. Talarowski (1977) also found that information about the mechanics of a simulation is not enough to produce cooperation and eliminate defection; this information must be coupled with an explanation of the benefits and risks of the game. Cass (1975) found that feedback about the status of the resource enhanced cooperative play and replenishment of the commons resource.

Other research has shown the effectiveness of random (Powers et al., 1980a) and player imposed fines (Powers & Boyle, 1983; Powers, et al., 1979) on controlling defection and cooperation in a commons simulation. Territoriality was effective in the sense that when subjects were assigned to specific portions of the resource to draw points from, the entire resource lasted much longer than when subjects are allowed to harvest from anywhere in the resource (Cass, 1975). The same was true out in the real world when the catches of lobstermen who had personal territories were more than the catches of lobstermen in general use territories (Acheson, 1975).

The remainder of the studies reviewed showed that larger resources last longer (Brechner, 1977; Dawes et al., 1977) that leadership had no effect except when combined with a high level of group participation in which decisions about the commons are unanimous (Shippee, 1978); that higher payoffs for defection were associated with more defection and less cooperation between members of the group (Kelley & Grzelak, 1972; Talarowski, 1977); that groups who shared earned points equally cooperated more and defected less than groups whose members retained points they had earned (Rubenstein et al., 1975); that open group play did not effect the level of cooperation or defection (Jerdee & Rosen, 1974); that males and females played commons simulations similarly (Dawes et al., 1977); and that group size had little effect (Dawes et al., 1977; Powers & Boyle, 1983) except when the group was large (18 players) (Smith et al., 1984).

Whereas several studies (Cass, 1975; Kelley & Grzelak, 1972) have attempted to assess what subjects learn in simulation settings, the measures used have concerned themselves with subjective analysis of perceptions, awareness, and attitudes. Only one study to date, (Powers & Boyle, 1983) has assessed behavioral changes. These researchers had subjects fill out posttests giving the subjects an opportunity to earn a large amount of points in one trial. Again, their results showed that subjects given more information in the simulation setting and in the fine condition cooperated more and defected less than other subjects on the posttest. Within the no fine condition, subjects allowed to communicate during the simulation and prior to the filling out of the posttest cooperated more than those not allowed to communicate in this condition. The significance of this finding is that subjects learn something from the gaming simulation that generalizes to another setting, suggesting that perhaps what is learned in the simulation setting will generalize to the real world. One significant weakness of this study was the lack of a control group that received no simulation. It is possible that some of these results could have been produced in a group that was not exposed to the simulation.

In summary, many studies have been reviewed and the variables effective in the simulation study have been outlined. Only one study to date, Powers and Boyle (1983) has attempted to assess generalization of what is learned in the simulation setting to another setting comparable to the real world in that subjects played only once, for a large number of points, and with an unknown referent group. The major limitation of previous research has been that it has not attempted to assess the generality of simulation findings. The one study that did (Powers & Boyle, 1983) failed to control for the effect of the game itself.

CHAPTER III

STATEMENT OF PURPOSE

The primary purpose of the present study was to determine whether behavior that occurred in a commons simulation also occurred on a one-trial posttest that was played with a large and unknown referent group and provided players with an opportunity to earn a large amount of points in a short period of time. Subjects had either prior experience with a commons dilemma game (game group) or were naive (no game group) prior to taking a posttest. The play of all the subjects on the large and the small group posttest was descriptively analysed. Posttest comparisons between conditions were made between the game and no game groups. In addition, the present study attempted to determine if a variable (fines) known to be effective in the simulation setting would continue its effectiveness in the posttests.

CHAPTER IV

METHODOLOGY

Overview

University students in three introductory Psychology courses were given a pretest during the first two weeks of the quarter. One form of the pretest required the subjects to make one of three choices: to cooperate, defect, or withdraw. The other form had four choices: to cooperate, defect, withdraw, or fine defectors. If the subjects received the pretest with the three options, they were assigned to the no fine group and if the subjects received the pretest with the fine option, they were assigned to the fine group.

During the second to ninth week of the quarter, groups of seven subjects, all from either the fine or no fine group, volunteered to participate in the study to earn extra points for their class grade. Subjects met in the Human Behavior Laboratory and were randomly assigned to the game or no game group.

Subjects in the game group received a commons simulation prior to the administration of two posttests. Subjects in the no game group received only the two posttests. All subjects were allowed to communicate with the members of their immediate group of seven prior to the filling out of each posttest. The large group posttest was administered first, then the second small group posttest was administered. Subjects played the large group posttest with all the subjects in their condition for that quarter. Subjects played the small group posttest only with members in their immediate group of seven. All subjects received posttests identical to their pretest.

Procedure

The basic design of this study was a 2 X 2 with fines versus no fines as one independent variable and game versus no game as the second independent variable (See Table 1 for a summary of the experimental design).

Pretest. During the second week of the quarter, all students in Dr. Powers Psychology 101 class were given a copy of the pretest to fill out. After the students made one of the choices, the tests were gathered and the students were assigned to either the fine or no fine condition. A list was made for each condition and posted for students to know which group they were in. Subjects not in attendance that day were given a chance to fill out the pretest at a later time.

Approximately one-half of the class received a pretest with the fine option and one-half of the class received the pretest without this option. Assignment was random in that the students sitting on one side of the room were given the pretest with the fine option and the students sitting on the other side of the room were given the pretest without the fine option.

Subjects. As subjects, 275 volunteer Psychology 101 students were used from three classes scheduled for fall, winter, and spring of Utah State University's 1982-1983 academic school year. During the second to ninth week of each quarter, the subjects participated in the experiment. Subjects volunteered at the end of each day's class to play the Commons Dilemma Game for class points (points

Table 1

Experimental Design

Group	Fines	Game	N
1	X	X	70
2	X	0	67
3	0	X	75
4	0	0	63

Note. The above table indicates whether the subjects received a posttest with the fine (X) or without the fine (0) option available and received the treatment (X) or no treatment (0) condition. All subjects received an identical pretest and two posttests.

earned in the game could make up to 10% of a student's class grade). Seven were accepted as subjects if they had not played the commons game, or participated as control subjects, and all seven belonged to either the fine or the no fine condition. The subjects were randomly assigned to the game or no game condition when they arrived at the Human Behavior lab. A list of randomly determined (coin toss) game or no game groups had been made at the beginning of each quarter and was used to assign groups to the game or no game condition.

Game. If the group was assigned to the game condition, the standardized instructions for the game were given and the commons game was played. Subjects in the game condition were given 5 colored cards: red, green, yellow, orange, and black as well as shields to conceal individual play of cards from the rest of the group. Subjects also received a record sheet on which they recorded their individual play (which was not to be seen by other players) and the number of points they earned on each trial of the game. Two experimenters were present each day to run the commons simulation, to record the group play on each trial, and to administer the posttests.

As part of the simulation, in the front of the room on another table a flipchart matrix and a pegboard were displayed. The flipchart matrix contained 17 matrices which determined the point values for the play of cooperative (red) and defection responses (green). The matrix was read by counting the number of red choices made by the individuals in the group. Table 2 shows one of the 17 matrices, the starting (zero) matrix for the Commons Game. An example of how to read the matrix follows: Suppose that on a trial the group plays 2 red cards and 5 green cards. The subjects who

Table 2

Zero Matrix for the Commons Dilemma Game

PLAY	PAY	
Number of red Choices	Red	Green
0	--	100
1-2	40	102
3	42	104
4	44	106
5	46	108
6	48	110
7	50	--

picked red would earn 40 points and subjects who played green would earn 102 points. The matrices reflect the status of the resource at any given time during the game. (See Appendix I for all the payoff matrices.)

A pegboard resembling a cribbage board served as a counting device and provided visual feedback to the players about the state of the point resource (See Appendix II). The pegboard contained a series of 10 holes marked off at regular intervals with each interval corresponding to one of the payoff matrices. The peg on the pegboard moved up or down and when it moved into the adjacent bin of ten holes, the payoff matrix was changed. For every green choice made, the peg moved down one hole on the pegboard. For every 10 holes the peg moved down, the payoff matrix changed and the payoffs for both red and green got smaller. This decrease simulated the depletion of a resource when the individuals in a commons take too much from the resource.

Periodically, on randomly chosen trials (variable trial 6.25), the peg was moved up a predetermined number of holes. The number of holes that the peg moved up was dependent upon the state of the resource, i.e., the matrix currently obtaining (See Table 3). This upward movement represented the replenishment of a biological resource through reproduction. If group play was predominantly red (cooperative), the payoff matrix gradually improved as the peg moved up the pegboard.

Besides the play of red and green cards, the game subjects could play yellow, orange, or black. The yellow card paid a player a

Table 3

The Replenishment Rate for Each Matrix

Matrix currently obtaining	0	±1–2	±3–4	±5–6	±7–8
Replenishment rate (move up)	8	7	6	5	4

low, fixed amount of points, (6 points) regardless of what the other players did. This option allowed players to withdraw from the commons when they did not fully trust the play of others and did not want to hurt others by defecting. In addition, it provided the group with some means to earn points when the resource was near an exhausted state. For example, in the -5 matrix, an all green play by the group would only earn each member 6 points. However, it would drive down the matrix considerably (7 holes on the pegboard). Since a yellow choice also earned 6 points and did not expend the resource, players could choose yellow when the matrix reached this level.

The orange and black cards were provided to allow the players some opportunity to control the behavior or play of others. Both cards cost the player 10 points to play. The orange card added 10 points to every player's score who played red. The black card negated any points that green earned for that trial and imposed an additional 20 point fine. For example, using the zero matrix of Table 1, if a play of 4 reds, 1 green, 1 orange, and 1 black were made by the members of a group, red would earn 52 points (42 for red and 10 more points because an orange was played), green would lose 20 points, orange would lose 10 points, and black would lose 10 points. The game consisted of at least 75 trials and lasted approximately 90 minutes. During the first 25 trials, players were not allowed to communicate with one another. During the next 50 trials conferences were allowed every 5 trials for 2 minutes if a majority of the individuals voted to do so at each opportunity. The game was generally ended on the 75th trial if the subjects had reached a solution that was not exploiting the commons, specifically, if members of the group were playing combinations of red, yellow, orange, and/or black for 15 consecutive trials or green was played by members of the group with group consent.

Posttests. After the game was played (or as soon as subjects were seated in the no game condition), two posttests (generalization tests) were administered to all the subjects. The first posttest (large group) was played with all the people in that condition for that quarter. The second posttest (small group) administered was played only with the seven subjects in the laboratory. The posttests consisted of a sheet of paper on which subjects could make choices identical to those made in the pretest (see Appendix III). Again, subjects could chose to cooperate, defect, or withdraw if they were in the no fine group or to cooperate, defect, withdraw, or fine a defector if they were in the fine group. To control for color preference that might occur during the game or from students talking to each other about the study across the quarter several forms of each test were available in which the names of numbers, geometric forms, or colors were associated with defection, cooperation, withdrawal, and/or fining.

Finally, standardized instructions (prepared for each group) were paraphrased to all groups prior to the Commons Game and the administration of all posttests (See Appendix IV for all standardized instructions given prior to treatment and the administration of the posttests). The instructions prior to the game explained the use of the cards, matrix, pegboard, and the general mechanics of the game, and provided a standardized reading of an analogue explanation on how the commons works. All groups (game and no game) received standardized instructions prior to the posttests which explained how to play the posttest, who the subjects were playing with, that they could talk among each other for 10 minutes, and that they should mark their posttest behind the shields provided so no one could see the choice they made. The standardized instructions for the large group posttest group were paraphrased, and the group filled out the posttest after communication. The small group posttest was then given with the standardized instructions for that group (same as large group posttest except that the referent group was the seven subjects in the room) and the posttest was then marked after an opportunity to communicate.

All groups were allowed to leave after the administration of both posttests.

Design Summary

In summary, the basic design was a 2 X 2 design with fines and treatments as independent variables (see Table 3). The dependent variables were the choices on the posttest. Chi Square analyses were performed between: 1) the game and no game groups on the large posttest; 2) the game and no game groups on the small posttest; 3) the fine and no fine groups on the large posttest; 4) the fine and no fine groups on the small posttest. Further, Chi Square Tests for Independence were performed using changes in choice from the pretest to the posttest for both the independent variables. Finally, a descriptive analysis of the differences between the game-no game and fine-no fine conditions given pretest choices were conducted. The data for five subjects who played the game twice were removed from the total N of 280, so posttest comparisons were based upon an N of 275. Pre- posttest comparisons were based on an N of 270, since five subjects did not take the pretest.

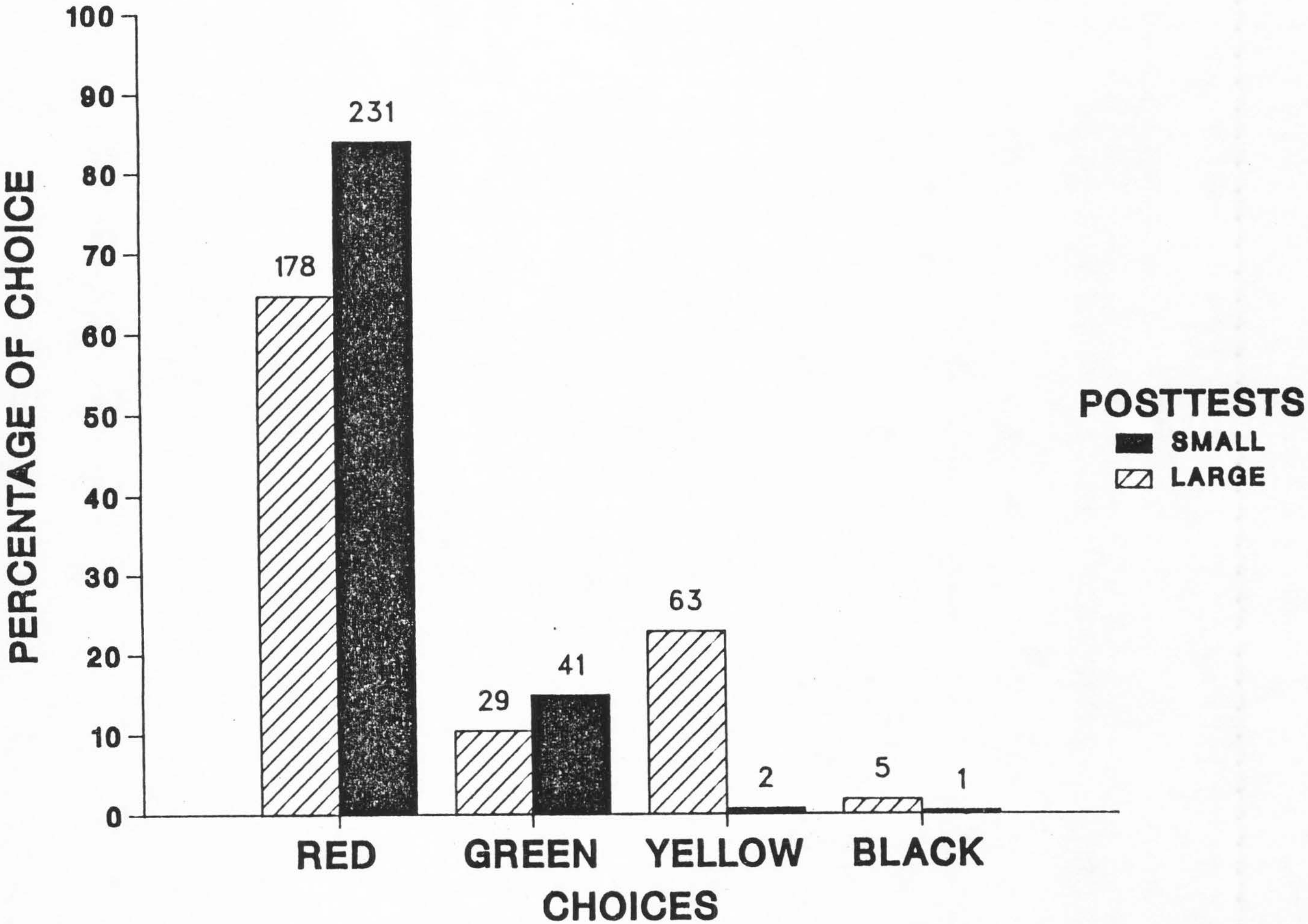
CHAPTER V

RESULTS

Figure 1 shows the percent of individuals who chose red (cooperated), green (defected), yellow (withdrew), or black (fined defectors) on the large and the small referent group posttest. On the large referent group posttest, 64.7 % chose red, 10.5% green, 22.9% yellow, and 1.8% black. On the small referent group posttest, 84.0% played red, 14.9% green, .7% yellow, and .4% black. Analyses of the results were descriptive because no adequate statistical test can be applied to the data. The results show that there are some large differences in the choices of the subjects as a function of their making a choice in the large referent group or the small referent group. On the large referent group posttest, subjects played 19% less red (65% to 84%) and 22% more yellow (23% to 1%) than they did on the small referent group posttest. Graphs of these differences across the game-no game condition and the fine-no fine condition are presented in Figures 2 through 5.

Figure 2 shows the choices of individuals across the game and the no game condition on the large referent group posttest. In the game condition, 51.7% subjects played red, 9.0% green, 36.6% yellow, and 2.8% black. In the no game condition, 79.2% subjects played red, 12.3% green, 7.7% yellow, and .8% black. A Chi Square Test for Independence indicated that there was a significant difference in the choices subjects made in the game and no game conditions on the large group posttest ($X^2 = 33.59$; $df = 2$; $p < .01$). Because of the low

Figure 1. The percentage of subjects who played red, green, yellow, or black on the small and large group generalization test. (Numbers above bars are number of subjects.)


PERCENTAGE OF CHOICE
100
90
80
70
60
50
40
30
20
10
0
178
231
29
41
63
2
5
1
RED
GREEN
YELLOW
BLACK
CHOICES
POSTTESTS
SMALL
LARGE

number of black choices made in the two conditions, black choices were eliminated from the Chi Square Analysis. Analysis of the contribution of each cell to the X^2 indicated that the primary differences in responding lay in the differences in which the two groups chose red and yellow. The subjects in the game condition withdrew more and cooperated less than subjects in the no game condition.

Figure 3 presents the choices of individuals on the small referent group posttest across the game and the no game conditions. In the game condition, 82.1% chose red, 15.9% green, 1.4% yellow, and .7% black. In the no game condition, 86.2% played red, 13.8% green, 0% yellow, and 0% black. A Chi Square Test for Independence indicated that there was no significant difference in the pattern of responding between the game and the no game conditions ($X^2 = .29$; $df = 1$; $p > .05$). Because of the low numbers of black and yellow played, only the choices of red and green were analyzed across the two groups.

Figure 4 illustrates the responses of the individuals in the fine and no fine conditions on the large referent group posttest. In the fine condition, 65.0% chose red, 8.0% green, 23.4% yellow, and 3.6% black. In the no fine condition, 64.5% played red, 13.0% green, and 22.5% yellow. A Chi Square Test of Independence indicated that there were no significant differences in the pattern of choices for the fine and the no fine groups ($X^2 = 1.47$; $df = 2$; $p > .05$). Black as a category in the Chi Square analysis was eliminated because it was not available in the no fine group.

Figure 2. The percentage of individuals who played red, green, yellow, or black on the large group posttest across the game-no game condition. (Numbers above bars are number of subjects.)

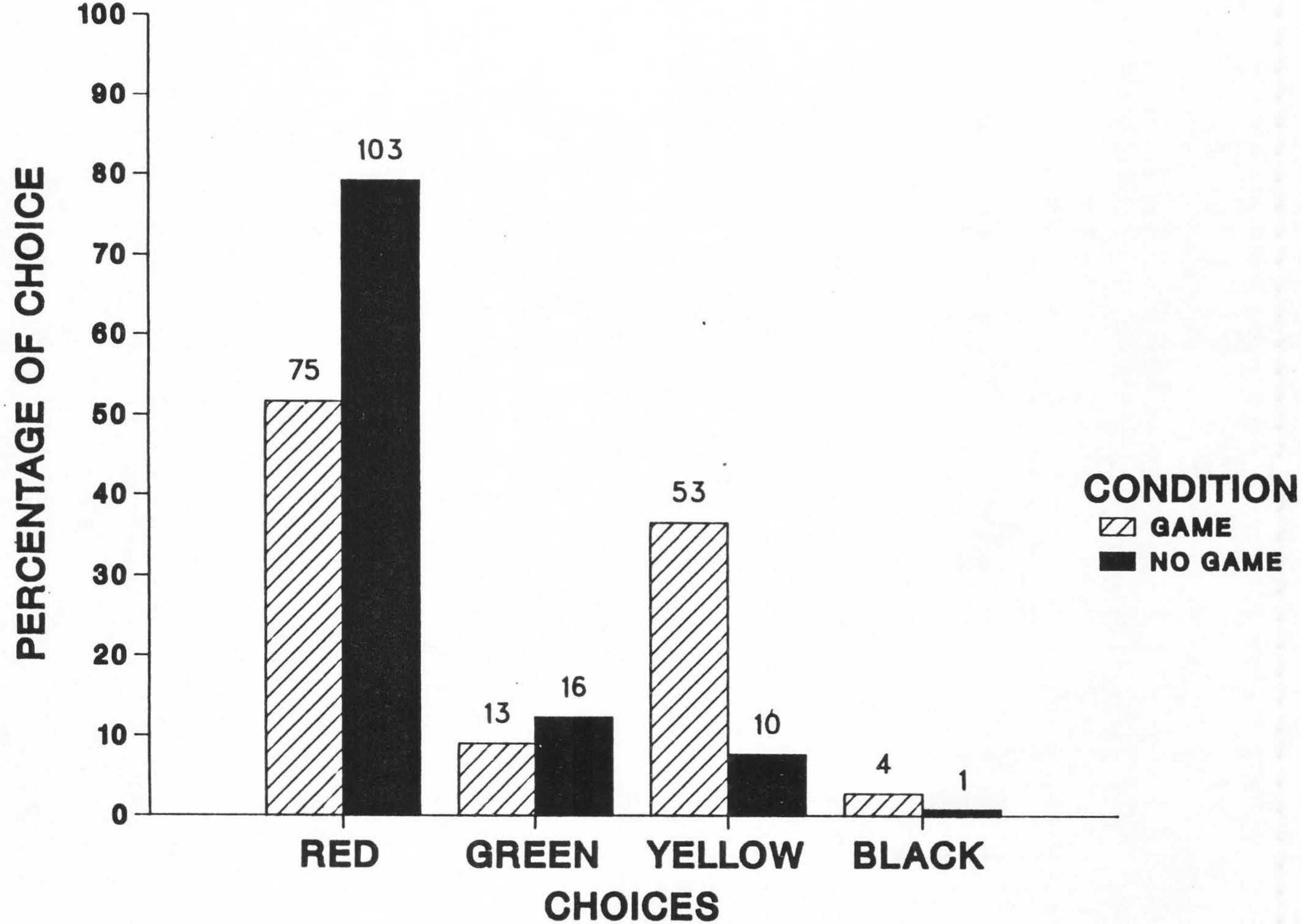
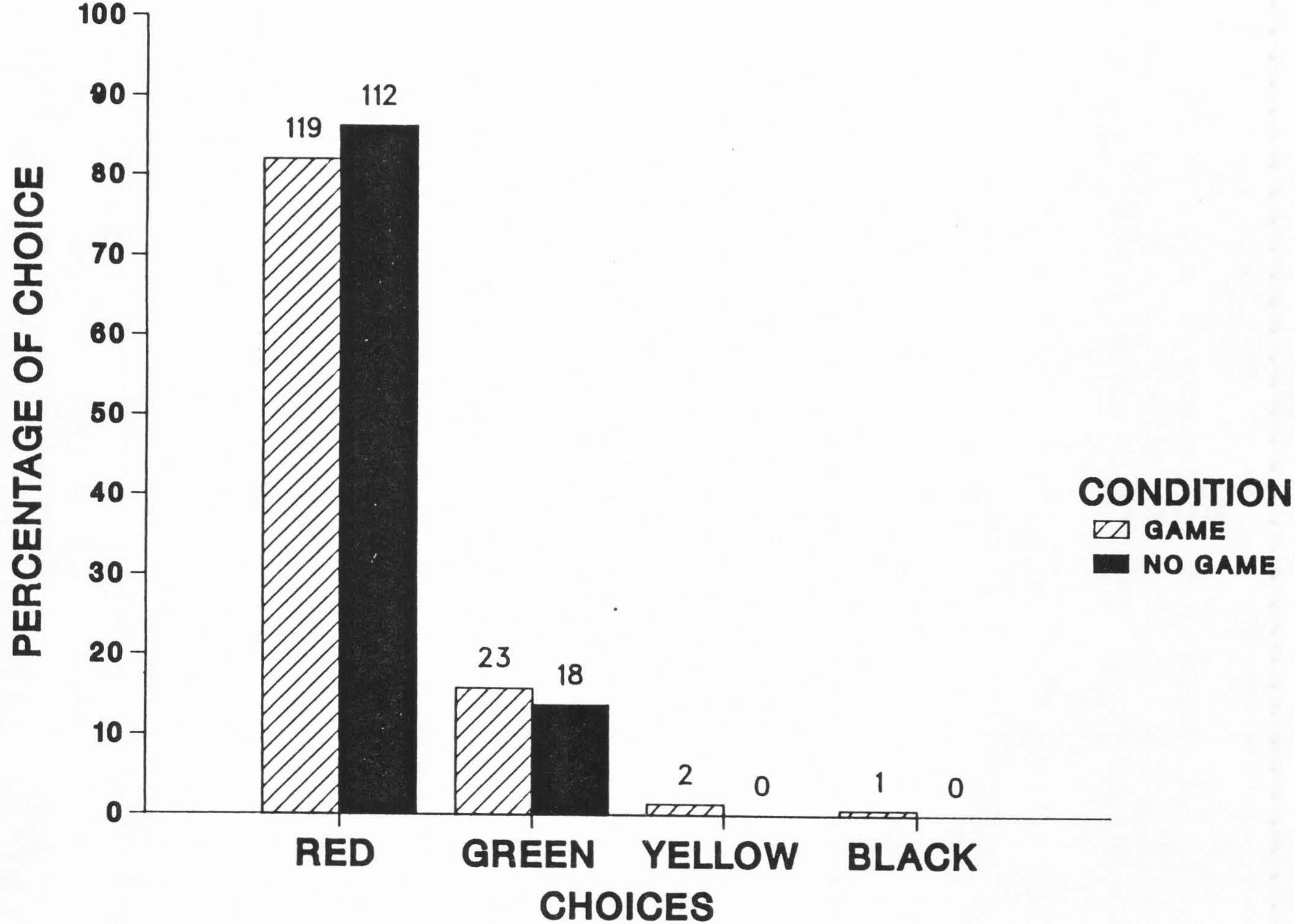

PERCENTAGE OF CHOICE
100
90
80
70
60
50
40
30
20
10
0
103
75
13
16
53
10
4
1
RED
GREEN
YELLOW
BLACK
CHOICES
CONDITION
GAME
NO GAME

Figure 3. The percentage of individuals who played red, green, yellow, or black on the small group posttest across the game-no game condition. (Numbers above bars are number of subjects.)



PERCENTAGE OF CHOICE
100
90
80
70
60
50
40
30
20
10
0
119
112
23
18
2
0
1
0
RED
GREEN
YELLOW
BLACK
CHOICES
CONDITION
GAME
NO GAME

Figure 4. The percentage of individuals who played red, green, yellow, or black on the large group posttest across the fine-no fine condition. (Numbers above bars are number of subjects.)

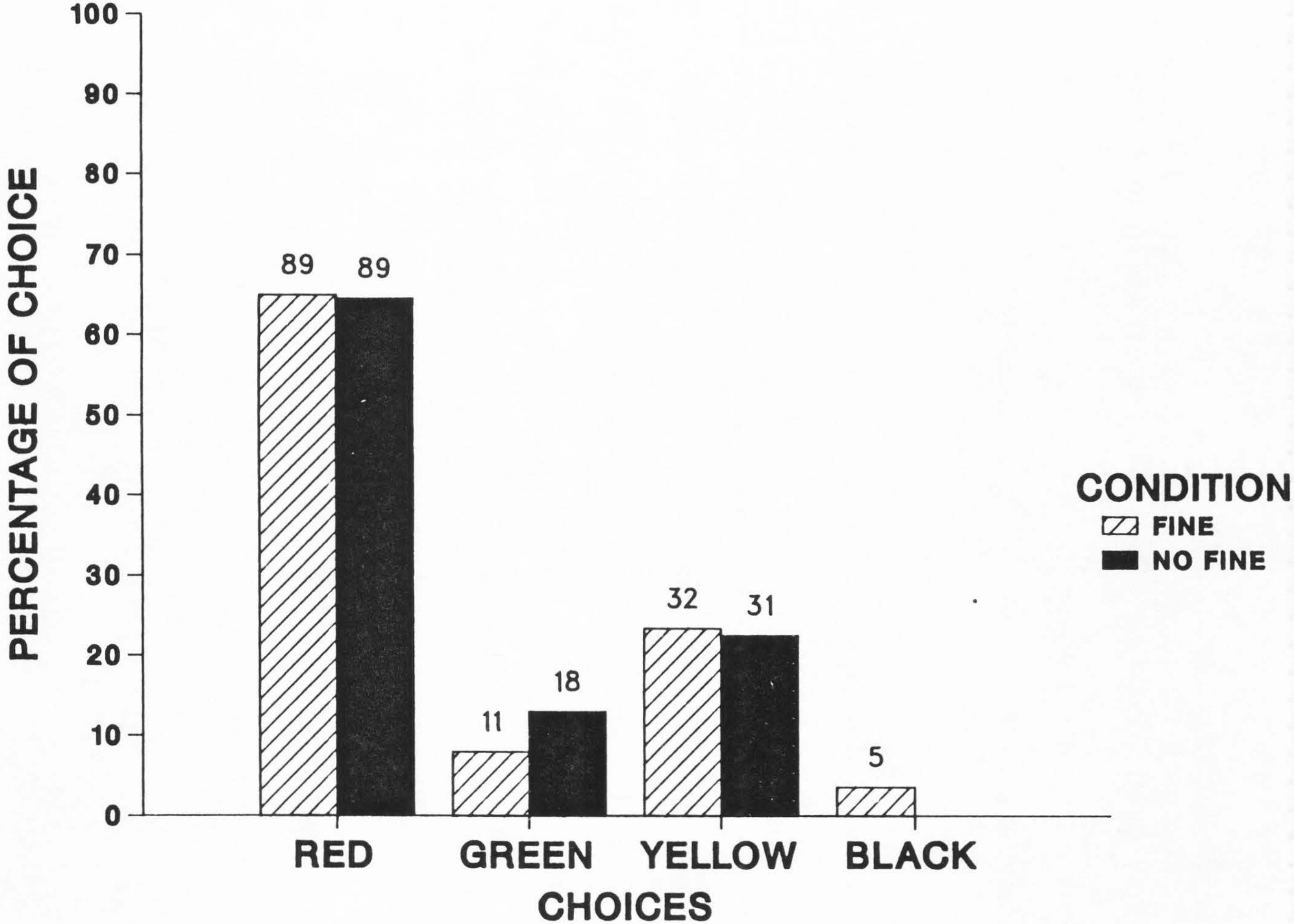

PERCENTAGE OF CHOICE
100
90
80
70
60
50
40
30
20
10
0
89
89
11
18
32
31
5
RED
GREEN
YELLOW
BLACK
CHOICES
CONDITION
FINE
NO FINE

Figure 5. The percentage of individuals who played red, green, yellow, or black on the small group posttest across the fine-no fine condition. (Numbers above bars are number of subjects.)

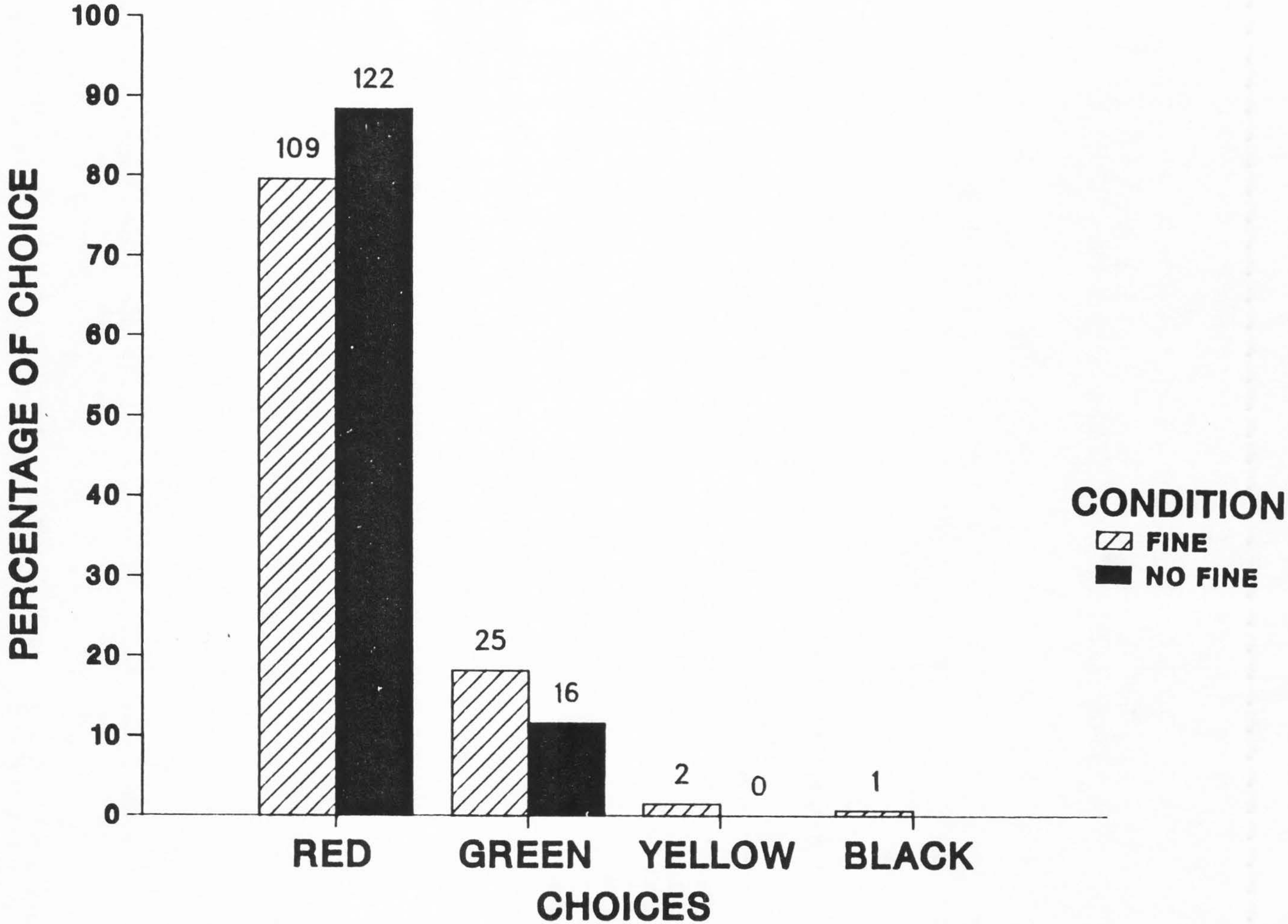

PERCENTAGE OF CHOICE
100
90
80
70
60
50
40
30
20
10
0
122
109
25
16
2
0
1
RED
GREEN
YELLOW
BLACK
CHOICES
CONDITION
FINE
NO FINE

Figure 5 shows the choices of the individuals in the fine and no fine group on the small referent group posttest. As may be seen, those in the fine condition were somewhat less likely to play red and more likely to play green than subjects in the no fine group. In the fine condition, 79.6% chose red, 18.2% green, 1.5% yellow, and .7% black. In the no fine condition, 88.4% played red, 11.6% green, and 0% played yellow. The results of a Chi Square Test for Independence showed that the observed differences in the choices of the individuals in the fine and the no fine condition on the small referent group posttest were not significant. ($X^2 = 2.64$; df = 1; $p > .05$). Black was eliminated from the analysis because one of the conditions did not have that choice available, and yellow was eliminated from the analysis because of the low number of individuals who made that choice.

Figure 6 illustrates the results of the game-no game and the fine-no fine conditions using pre- posttest comparisons. Detailed breakdowns by number and per cent for the fine-no fine and the game-no game conditions are shown in Tables 4 and 5, respectively, in Appendix 5. For each main condition, the three plots show the per cent of red, green, yellow, and black played <u>given</u> the subjects play in the pretest. For the game-no game condition, the subjects who played red in the pretest in the game group played 22.3% more yellow and 26.5% less red on the posttest than the subjects who played red on the pretest in the no game condition. These values were obtained by subtracting the per cent of red and yellow played on the small posttest from the large posttest. For example, subjects on the large posttest in the game condition played 57.1% red and 33.8% yellow while subjects in the no game condition played 83.6% red and 11.5% yellow. The subjects who played green on the pretest in the game group played 28.7% more yellow and 26.8% less red on the posttest than the subjects who played green on the pretest in the no game group. The subjects who played yellow on the pretest in the game group played 45.9% more yellow and 36.6% less red on the posttest than the subjects who played yellow on the pretest in the no game group. In general, subjects in the game group played less red and much more yellow on the posttest than subjects in the no game group.

For the fine-no fine condition, the subjects who played red on the pretest in the fine group played .8% more yellow and 6.4% less red on the posttest than subjects in the no fine group. Subjects who played green on the pretest in the fine group played 3.3% more yellow and 8.5% more red on the posttest than subjects who played green on the pretest in the no fine group. Subjects who played yellow on the pretest in the fine group played 9.4% more red and 15.8% less yellow on the posttest than subjects who played green on the pretest in the no fine group. In general, subjects showed no consistent pattern in their play of red or yellow as a function of being in the fine or no fine group.

A Chi Square Test of Independence was performed across the game and no game conditions on the number of subjects that changed to yellow versus the number in all other categories. That is, in the game group, 41 subjects switched to yellow and 102 subjects either played the same as they did in the pretest or switched to red, green, or black. In the no game group, 10 subjects switched to yellow and 117 subjects either did not change from the pretest or switched to red, green, or black. The results of a Chi Square Test for Independence showed that there was a significant difference in the pattern of responding between the game and the no game groups ($X^2 = 14.8$; df = 1; $p. < .01$).

A Chi Square Test for Independence was also performed across the fine-no fine condition on the number of subjects who switched to yellow versus all other categories. For the fine group, 24 switched to yellow and 101 made other choices. For the no fine group, 27 switched to yellow and 118 made other choices. The results of a Chi Square Test for Independence indicated that there was no significant difference in the pattern of choices for the fine and no fine groups ($X^2 = .02$; df = 1; $p > .05$).

Figure 7 shows the results of the game versus no game condition within the fine and no fine groups. Detailed breakdowns by frequency and per cent for both the fine and the no fine condition are shown in Tables 6 and 7 in Appendix 5. For the two levels of the fine-no fine condition, the frequency and per cent of red, green, yellow and black on the posttest given subjects' pretest choices were plotted. For the fine group, subjects who played red on the pretest in the game group played 19.2% more yellow and 25.0% less red on the posttest than subjects who played green on the pretest in the no game group. Subjects who played green on the pretest in the game group played 36.6% more yellow and 31.0% less red on the posttest than subjects who played green in the pretest in the no game group. Subjects who played yellow on the pretest in the game group played

33.3% more yellow and 42.9% less red than subjects who played green in the pretest in the no game group. Within the no fine group, subjects who played red on the pretest in the game group played 25.4% more yellow and 27.6% less red on the posttest than subjects who played green on the pretest in the no game condition. Subjects who played green on the pretest in the game group played 24.7% more yellow and 24.0% less red than subjects who played green on the pretest in the no game group. Subjects who played yellow in the pretest in the game condition played 58.3% more yellow and 28.3% less red on the posttest than subjects who played green on the pretest in the no game condition. In general, the results substantiated the findings of the game-no game comparisons (left side of Figure 6), extending the results to show that the differences between the game and no game groups occurred within the fine and no fine groups.

Figure 6. The percentage of posttest choices given pretest choice for the game-no game condition and fine-no fine condition.

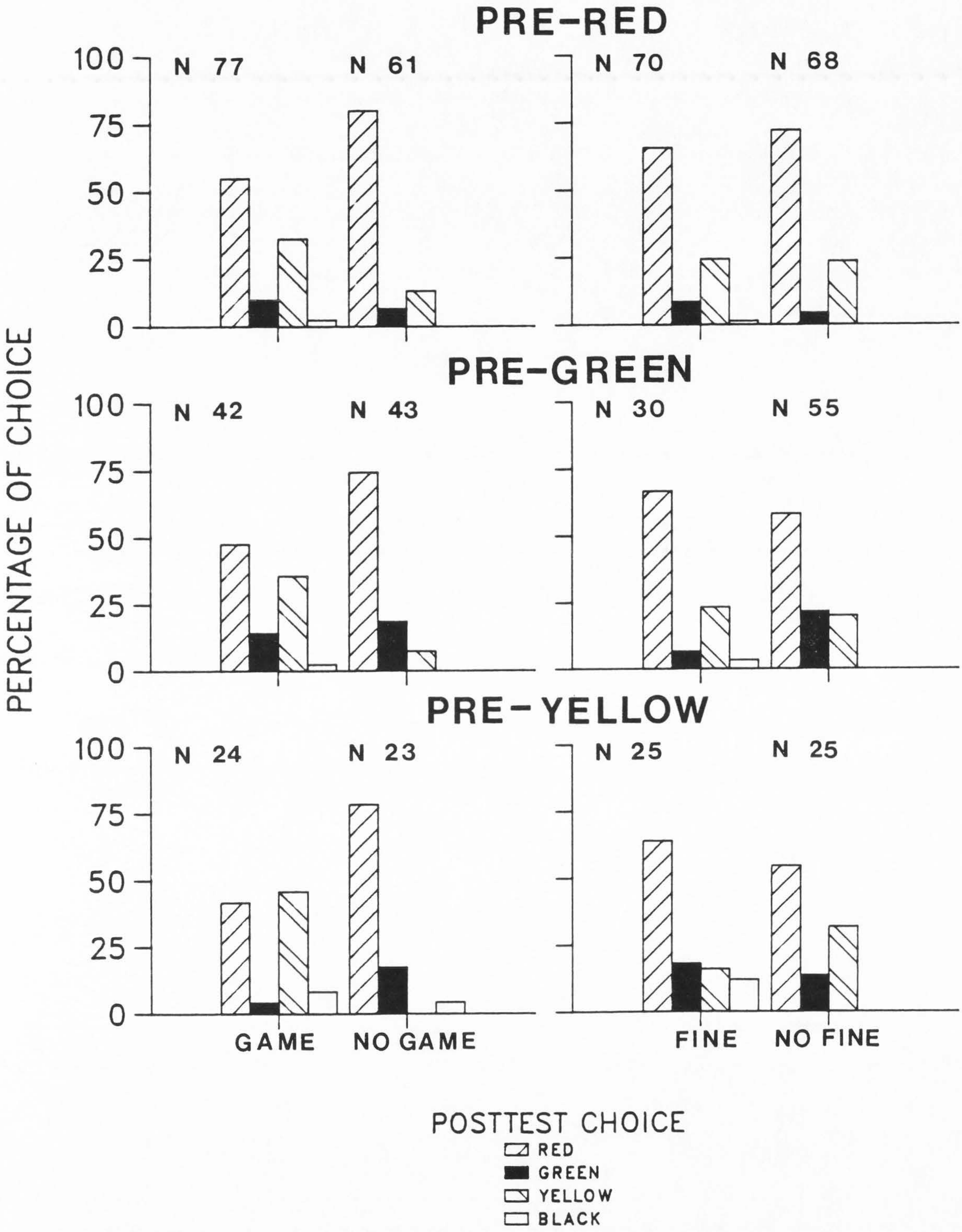
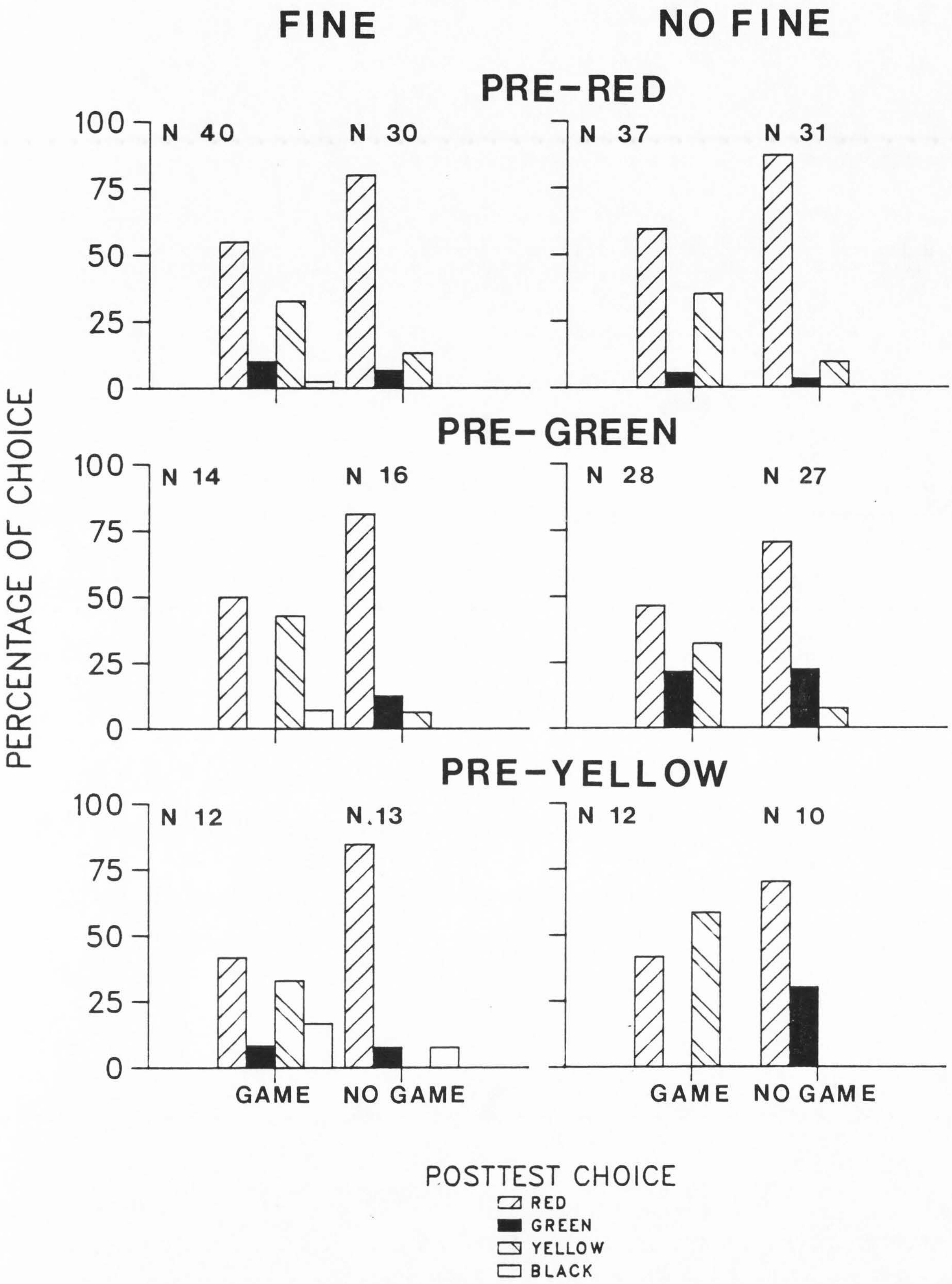

PRE-RED
PRE-GREEN
PRE-YELLOW
PERCENTAGE OF CHOICE
100
75
50
25
0
N 77
N 61
N 70
N 68
N 42
N 43
N 30
N 55
N 24
N 23
N 25
N 25
GAME
NO GAME
FINE
NO FINE
POSTTEST CHOICE
RED
GREEN
YELLOW
BLACK

Figure 7. The percentage of posttest choices given pretest choice across the game-no game condition within the fine and no fine groups.



FINE
NO FINE
PRE-RED
N 40
N 30
N 37
N 31
PRE-GREEN
N 14
N 16
N 28
N 27
PRE-YELLOW
N 12
N.13
N 12
N 10
100
75
50
25
0
PERCENTAGE OF CHOICE
GAME
NO GAME
POSTTEST CHOICE
RED
GREEN
YELLOW
BLACK

CHAPTER VI

DISCUSSION

More cooperation and less defection did not generalize from a commons simulation to a posttest that incorporated several real world features. However, the game did have one significant effect! In general, the results showed that subjects who played the commons game played the large group posttest differently than subjects who did not play the game. More specifically, subjects who participated in the commons dilemma simulation played many more withdrawal responses on the posttest when that posttest was played with a large unknown referent group. In addition, a descriptive pre- posttest analysis showed that more yellow and less red were played in the game group than in the no game group and that this effect was consistent within the fine and the no fine conditions. A Chi Square analysis between the game and no game groups on subjects' pretest and posttest responses showed that subjects in the game condition switched to play more yellow (withdrawing at a greater frequency than subjects in the no game group). While there were no differences in the play of the game and no game subjects on the small group posttest, there were large visible differences in how the game group played the small and the large posttest. Specifically, subjects on the large posttest cooperated less and withdrew from the game more than on the small posttests.

In contrast to the game versus no game results, there were no differences in the play of the fine and no fine groups on either the large or the small group generalization posttest. A descriptive pre-posttest analysis showed that no differences existed in the play of these groups. A Chi Square analysis also showed no significant effect when the change to yellow versus all other possible choices was analyzed.

The result that game subjects played the large and small group posttests differently was not surprising. During the simulation, groups typically struggled with the problem of trusting and cooperating with one another. Subjects often made agreements with each other and broke those agreements after several trials during the first half of the simulation. In addition, the state of the resource diminished as a consequence of green play. One might expect that when experienced subjects played with a large unknown referent group that they would be more cautious about the play of unknown people. Reference to the difficulty of trusting unknown players was frequently made by the game subjects when they conferenced prior to the marking of the large posttest. Also, prior to marking the small posttest, subjects frequently indicated that they should be able to trust each other and they sought commitments from each other prior to marking the posttest.

That subjects in the game condition withdrew more frequently from the commons posttest is a result that is different from the data that has come directly from other research (Dawes, 1980). The gaming research has suggested that experience in a commons simulation that allows communication leads to more cooperation and less defection. One major reason for this difference may be that many games only allow subjects to make polar choices, that is, to defect or to cooperate, to take points or not to take points. The results of this study suggest that researchers may need to consider the impact of other choices on the behavior of individuals in a commons. In the present study, yellow was an additional choice that allowed subjects to withdraw from play for a low salary. The frequent use of this choice by subjects in the game condition on the play of the large posttest suggests that the commons experience has made players cautious or distrustful of other players. Evidence for this was the Chi Square analysis of the yellow play which showed that a significant number of subjects in the game condition switched to yellow on the posttest from red or green on the pretest. Other anecdotal evidence for this conclusion was obtained from the play of subjects during the commons simulation and the conferences held prior to the play of the posttests. Typically, during the game, defection occurred many times, lowering the value of the resource, so that subjects earned more points playing yellow or green. If a subject acted only for immediate individual profit, he/she would choose to play green (defection) consequently exploiting the other players and bringing about the demise of the commons. The player could choose yellow (withdrawal) if he/she didn't want to harm others and did not trust other players completely. During conferences subjects usually agreed to play all yellow or all red and one orange and further agreed that no one should play green. Frequently, several defections still occurred angering and frustrating some players as evidenced by loud sighs and complaints when the count was presented by the game manager. During the conference prior to the large posttest, some subjects discussed the simulation experience and indicated that other players (in the immediate simulation group or in the larger group they were playing with) could not be trusted, indicating that at least four people would try to "cheat" and resulting in the fact that cooperators would earn less than withdrawers. This suggests that players withdrew to protect themselves from being exploited by green (exploitative) players.

Because subjects in the treatment and no treatment groups played the small posttest similarly further implicated the role of caution when subjects played the large posttest in an unknown group. In the conference prior to the marking of the small group posttest, subjects indicated the value of all playing red, that more than half of the seven member group must play green to receive low points for cooperation, and that subjects should therefore commit themselves to play red verbally. Subjects also appeared more willing to trust players that they could communicate with and could see. Thus, it seemed that playing the posttest only with members of their immediate face-to-face group elicited more communication and trust because of the groups' apparent ability to control its own outcome with much less risk to itself.

The results of the fine and no fine groups suggest that the effects of fines in these simulations did not generalize. This finding, however, is contrary to the findings of Powers and Boyle (1983) which found that the fine option did generalize to a posttest similar to the one used here. One explanation for this result may be that the fines themselves were ineffective because the user would have had to give up the opportunity to earn a large number of points (a subject choosing black forfeits the chance to earn 14 class points in a cooperative group). Alternatively, the fines may have been ineffective because no one thought they would be used.

The importance of being able to show that generalization from a commons simulation will occur cannot be overstressed. If this research is to have some ultimate utility, it must be shown that experiences learned in the commons simulation will be useful in helping to solve real world commons problems. Further, it must be shown that variables effective in the simulation environment will also be effective in the real world. If this can be shown, then we can use empirically verifiable criteria for making policy decisions about the best course of action to eliminate resource destruction and produce effective resource management in the real world.

Before closing, several points about the present research should be addressed. It could be argued that the dependent measures used in this study were relatively weak measures of generalization, that they were too similar to the simulation. While this may be true, there are several features about the posttests that were important. 1) The posttests were one trial, that is subjects did not have an opportunity to correct their play based upon feedback from the other members' play. 2) The individuals played for a large number of points. The points the subjects could earn on one trial were often more than they could earn by playing the entire game. 3) For the large posttest, the subjects played with many players whose identities were unknown. This latter attribute alone simulates a very real aspect of the world, i.e., that there are many unknown people using the same resource.

One way the effectiveness and validity of this research might be improved is by using a posttest in which individuals play for money, a very generalized reinforcer. The advantage of using money would be that the resource is different from class points for grades, giving more credibility to the notion that generalization has occurred. Another advantage is that money is such a generalized reinforcer that it would definitely motivate subjects to defect. Consequently, generalization in the posttest in groups playing the game would have much more validity than in the present research which used class points in the game and the posttests.

In summary, the results of the present study support the conclusion that subjects change from exposure to a commons simulation, specifically, that subjects obtain, perhaps, a more realistic view of the real world.

REFERENCES

Acheson, J. M. (1975). The lobster fiefs: economic and ecological effects of territoriality in the Maine lobster industry. Human Ecology, 3, 183-207.

Boniecki, G. J. (1977). Is man interested in his future? The psychological question of our times. International Journal of Psychology, 12, 59-64.

Brechner, K. C. (1977). An experimental analysis of social traps. Journal of Experimental Social Psychology, 13, 552-564.

Cass, R. C. (1975). Territoriality and the tragedy of the commons: a social trap analysis. Unpublished doctoral dissertation, Arizona State University.

Crowe, B. L. (1969). The tragedy of the commons revisited. Science, 166, 1103-1107.

Dawes, R. M. (1973). The commons game: a n-person mixed-motive game with a dominating strategy for defection. Oregon Research Institute Research Bulletin, 13, No. 2.

Dawes, R. M. (1980). Social dilemmas. Annual Review of Psychology, 31, 169-193.

Dawes, R. M., McTavish, J. & Shaklee, H. (1977). Behavior, communication, and assumptions about other people's behavior in a commons dilemma situation. Journal of Personality and Social Psychology, 35, 1-11.

Edney, J. J. (1979). The nuts game: a concise commons dilemma analogue. Journal of Psychology and Nonverbal Behavior, 3, 252-254.

Edney, J. J. (1980). The commons problem: alternative perspectives. American Psychologist, 35, 1-11.

Edney, J. J., & Harper, C. S. (1978a). Heroism in a resource crisis: a simulation study. Environmental Management, 2, 523-527.

Edney, J. J., & Harper, C. S. (1978b). The commons dilemma: a review of contributions from psychology. Environmental Management, 2, 491-507.

Edney, J. J., & Harper, C. S. (1978c). The effects of information in a resource management problem: a social trap analysis. Human Ecology, 6, 387-395.

Hardin, G. (1968). Tragedy of the commons. Science, 162, 1243-1243-1248.

Jerdee, T. H., & Rosen, B. (1974). Effects of opportunity to communicate and vissbility of individual decisions on behavior in the common interest. Journal of Applied Psychology, 59, 712-716.

Kelley, H. H., & Grzelak, J. (1972). Conflict between individual and common interest in an n-person relationship. Journal of Personality and Social Psychology, 21, 190-197.

Linder, D. (1982). Social trap analogues: the tragedy of the commons in the laboratory. V.J.Derlega & J. Grzelak (Eds.), Cooperation and helping behavior (pp. 183-205). New York: Academic Press.

McHugh, R. L. (1977). Rise and fall of world whaling: the tragedy of the commons illustrated. Journal of International Affairs, 31, 23-33.

McTavish, J. (1977). Is game behavior related to behavior in any other situations? Paper presented at American Psychological Association, San Francisco, August.

Norton, R. S. & Powers, R. B. (1981). Commons dilemmas. Unpublished manuscript, 1981. (Available from Utah State University, Logan, Utah 84322.

Platt, J. (1973). Social Traps. American Psychologist, 28, 641-651.

Powers, R. B. & Boyle, William. (1983). Generalization from a commons dilemma game: the effects of a fine option, information, and communication on cooperation and defection. Simulation and Games, 14, 253-274.

Powers, R. B., Duus, R. E., & Norton, R. S. (1979). The commons game: teaching students about social traps. Presented at the meeting of the Rocky Mountain Psychological Association, Las Vegas, Nevada.

Powers, R. B., Duus, R. E., & Norton, R. S. (1980a). Cooperation and defections in a commons game: The effects of sanctions and opportunity to communicate. Paper presented at the annual meeting of the North American Simulation and Gaming Association, Ashville, North Carolina.

Powers, R. B., Duus, R. E., & Norton, R. S. (1980b). The Commons Game. Unpublished manuscript. (Available from Utah State University, Logan, Utah 84322.

Rubenstein, F. D., Watzke, G., Doktor, R. H., & Dana, J. (1975). The effect of two incentive schemes upon the conservation of shared resource by five-person groups. Organizational Behavior and Human Performance, 13, 330-338.

Shippee, G. (1978). Leadership, group participation, and avoiding the tragedy of the commons. Unpublished doctoral dissertation, Arizona State University.

Shippee, G. (1980). Energy consumption and conservation psychology: a review and conceptual analysis. Environmental Management, 4, 297-314.

Smith, J., Powers, R. B., & Boyle, W. (1984). Conservation and greed in the commons game: the effects of group size. Paper presented at the meeting of the Northwest Undergraduate Research Symposium, Central Washington University, Ellensburg, Washington, April.

Stern, P. C. (1976). Effects of incentive and education on resource conservation decisions in a simulated commons dilemma. Journal of Personality and Social Psychology, 34, 1285-1292.

Stern, P. C. (1978). When do people act to maintain common resources? a reformulated psychological question for our times. International Journal of Psychology, 13, 149-158.

Talarowski, F. S. (1977). Effects of moralizing and individual incentive in a decomposed commons dilemma. Paper presented at the meeting of the American Psychological Association, San Francisco, August.

APPENDICES

Appendix I

Payoff matrices for the Commons Dilemma Game

The present appendix contains the 17 payoff matrices for the Commons Dilemma Game. The matrices are ordered from worst (-8) to best (+8). Within each matrix, there are three column headings: N of R (number of red), R (red), G (green). To find the payoffs for red and green for a given trial and matrix, count the number of red played by the group and find that number in the N of R column. Then, find the payoff for red and green in the columns under R and G, respectively, and on the same row as the actual number of red played.

-8

N of R	R	G
0	--	0
1-2	-10	2
3	- 8	4
4	- 6	6
5	- 4	8
6	- 2	10
7	0	--

-7

N of R	R	G
0	--	2
1-2	-9	4
3	- 7	6
4	- 5	8
5	- 3	10
6	- 1	12
7	1	--

-6

N of R	R	G
0	--	4
1-2	-8	6
3	- 6	8
4	- 4	10
5	- 2	12
6	0	14
7	2	--

-5

N of R	R	G
0	--	6
1-2	- 7	8
3	- 5	10
4	- 3	12
5	- 1	14
6	1	16
7	3	--

-4

N of R	R	G
0	--	14
1-2	- 3	16
3	- 1	18
4	1	20
5	3	22
6	5	24
7	7	--

-3

N of R	R	G
0	--	26
1-2	3	28
3	5	30
4	7	32
5	9	34
6	11	36
7	13	--

-2

N of R	R	G
0	--	46
1-2	13	48
3	15	50
4	17	52
5	19	54
6	21	56
7	23	--

-1

N of R	R	G
0	--	70
1-2	25	72
3	27	74
4	29	76
5	31	78
6	33	80
7	35	--

0

N of R	R	G
0	--	100
1-2	40	102
3	42	104
4	44	106
5	46	108
6	48	110
7	50	--

1

N of R	R	G
0	--	130
1-2	55	132
3	57	134
4	59	136
5	61	138
6	63	140
7	65	--

2

N of R	R	G
0	--	154
1-2	67	156
3	69	158
4	71	160
5	73	162
6	75	164
7	77	--

3

N of R	R	G
0	--	174
1-2	77	176
3	79	178
4	81	180
5	83	182
6	85	184
7	87	--

4

N of R	R	G
0	--	180
1-2	83	188
3	85	190
4	87	192
5	89	194
6	91	196
7	93	--

5

N of R	R	G
0	--	194
1-2	87	196
3	89	198
4	91	200
5	93	202
6	95	204
7	97	--

6

N of R	R	G
0	--	196
1-2	88	198
3	90	200
4	92	202
5	94	204
6	96	206
7	98	--

7

N of R	R	G
0	--	198
1-2	89	200
3	91	202
4	93	204
5	95	206
6	97	208
7	99	--

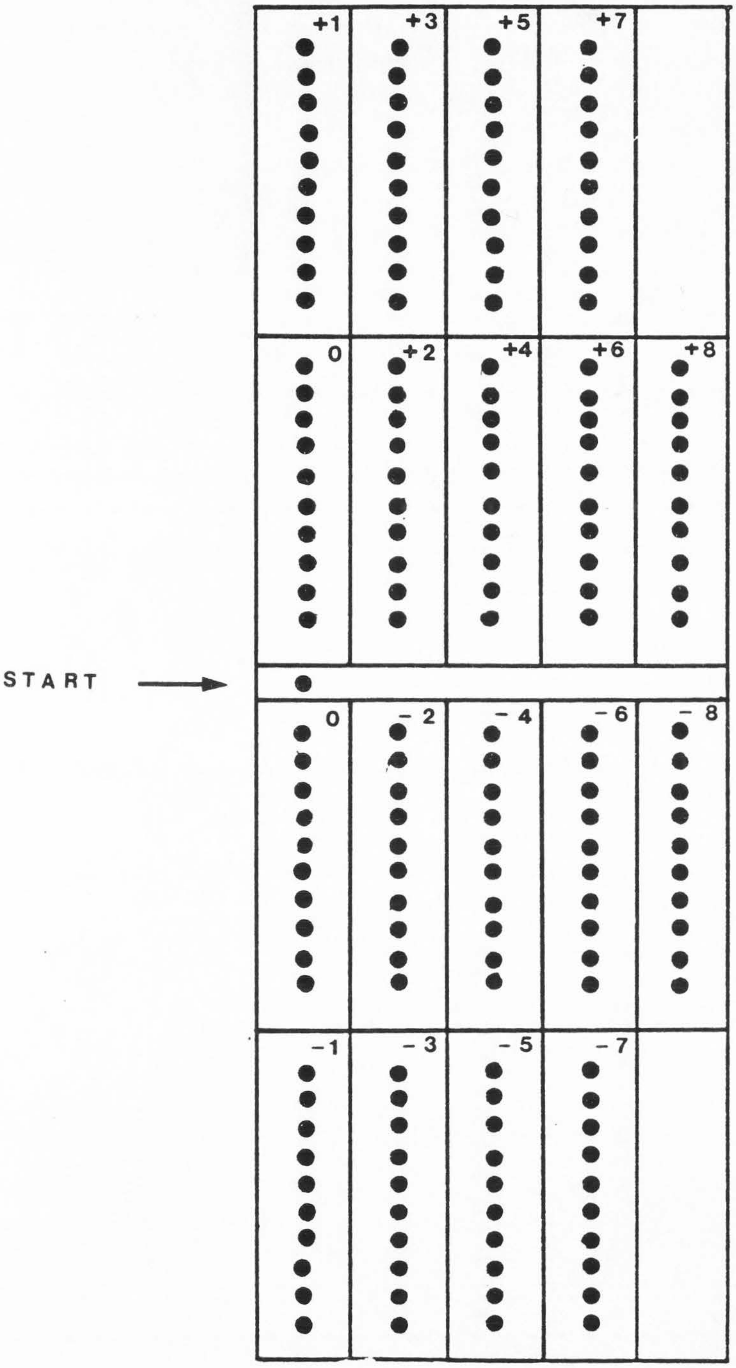
8

N of R	R	G
0	--	200
1-2	90	202
3	92	204
4	94	206
5	96	208
6	98	210
7	100	212

Appendix II

Pegboard for the Commons
Dilemma Game

Every 10 holes from the starting point effects a change in the matrix. The numbers in the top right hand corner of each bin indicate the particular matrix associated with that bin.



Appendix III

The following two pages contain two samples of the posttests used to assess generalization. The first posttest is an example containing the fine option; the second posttest is and example in which the fine option is absent.

MALE ____________________ NAME ____________________

FEMALE ____________________ DATE ____________________

PROCTOR ____________________

Commons Game (1 trial only)

The game described below is a one-trial only game that you play with others who have the same experience as you in this game. Thus, if you have played once, you will be playing with only those who have played once. If you've played twice, you will be playing with those who have played twice, etc. The points listed in the matrix are class points and will be added to your total which counts towards your grade. When you have made your choice and filled in the information required, fold the paper in half and give it to Dr. Powers.

Thank you.

Play	(Number of) Red	(Number of) Green	Pay (Class Points) Red	Pay (Class Points) Green
All Red	(N)	0	12	--
All Red but 1	(N-1)	1	10	20
All Red but 2	(N-2)	2	8	16
All Red but 3	(N-3)	3	6	12

Any other combination earns 1 point for red; 2 points for green

Black = earns nothing but fines any green 3 points

Yellow= earns 3 points regardless of what anyone else does

Check one:

Red Green Yellow Black

I have played this game:
Check one:

Never Once Twice 3 Times More

MALE ____________________ NAME ____________________

FEMALE ____________________ DATE ____________________

PROCTOR ____________________

Commons Game (1 trial only)

The game described below is a one-trial only game that you play with others who have the same experience as you in this game. Thus, if you have played once, you will be playing with only those who have played once. If you've played twice, you will be playing with those who have played twice, etc. The points listed in the matrix are class points and will be added to your total which counts towards your grade. When you have made your choice and filled in the information required, fold the paper in half and give it to Dr. Powers.

Thank you.

Play	(Number of) Red	(Number of) Green	Pay (Class Points) Red	Pay (Class Points) Green
All Red	(N)	0	12	--
All Red but 1	(N-1)	1	10	20
All Red but 2	(N-2)	2	8	16
All Red but 3	(N-3)	3	6	12

Any other combination earns 1 point for red; 2 points for green

Yellow= earns 3 points regardless of what anyone else does

Check one:

Red Green Yellow

I have played this game:
Check one:

Never Once Twice 3 Times More

Appendix IV

<u>Standardized instructions for the Commons Dilemma Game</u>

Today, you are going to play the Commons Dilemma Game and you will have an opportunity to each earn some class points for extra credit. To begin with, you should know and remember that 100 game points equals one of your class points.

In front of each of you should be a record sheet, a shield, and five differently colored cards: red, green, yellow, orange, and black. In a few minutes you are going to play the commons game. The game is played for 50 to 100 trials and on each trial I will ask you to play a card. And, it is by playing cards that each of you will earn points. Let's talk about how you earn points using the cards.

The first two cards we will talk about are the red and the green cards. The payoff or the number of game points you will earn on a given trial for a play of red or green is determined by the payoff matrix (the game manager points to the flipchart at the front of the room). Specifically, the number of red cards that is played by the group on a given trial determines the number of points that red and green earn for that trial. To read the matrix, find the number of red played by the group in the "number of red played" column on the matrix (the game manager traces through this procedure while explaining). Then, read across the row. The first number, under the red column, is what red earns; the second number, under the green column, is what green earns for that trial. Let's take an example using the zero matrix. Suppose the group plays 4 red cards and 3 green cards. The individuals who played red would earn 44 points and the individuals who played green would earn 106 points. (Again, the game manager traces through the matrix.) O.K., let's take another example. How many points would each red and green player earn if 2 red cards and 5 green cards were played? (The game manager will pick one of the subjects to answer and will agree or disagree with the response. If the answer given is incorrect the game manager will explain the how the values for red and green plays were reached.) Are there any questions? (The game manager will answer any questions paraphrasing the instructions given above or deferring any questions that will be answered later.)

Before you there is also a yellow card. If you play the yellow card on a given trial, it will give you 6 points. That is, you will earn 6 points regardless of what the other players in the group do on that trial.

Black is another card before you that you may play on any trial. Now, black costs you 10 points to play and negates any pay for green as well as imposing a 20 point loss on those playing green. Specifically, if a black is played, any one who plays green on that trial will lose 20 points and the person who plays black will lose 10 points. Remember, black costs 10 points to play but it fines all green players 20 points.

The final card available for play is the orange card. Like black, orange also costs 10 points to play but it gives all red players 10 additional points. That is, if orange is played on a trial and you play red, you will earn the value on the matrix that red earns plus 10 more points. Orange will lose 10 points.

Now let's have another example. Suppose 1 red, 3 green, 1 yellow, 1 orange, and 1 black are played. Well, red would earn 50 points--40 for red and 10 because someone played orange; green would lose 20 points--because someone played a black green does not earn what it would have otherwise, 102 points. Yellow would earn 6 points and orange and black would each lose 10 points.

Are there any questions about the values of cards and how they work? (The game manager will only ask questions about what has gone before. Any questions about why someone would play some of the cards was responded to by indicating that an important part of the game is for the group to discover its own stategies.)

In front of the room you will note that there is a pegboard next to the flipchart matrix (the manager will point). For each green that is played by the group, the peg on the pegboard will move down one hole. When the peg moves down 10 holes and into the next bin, which is separated by the dark heavy red or green lines, the matrix will get worse. That is, for each 10 holes that the peg moves down, the matrix will get worse. Every so often, at a predetermined and random time, the peg will move up a predetermined number of holes. There is nothing that you can directly do to move the peg upwards. If the peg moves up and into the next bin, the matrix will change and it will be for the better. In summary, the only play that makes things worse is green; if any other card is played it will not affect the matrix for better or for worse. Are there any questions? (Only questions relating to what has been discussed will be answered.)

Now there are only a couple of more things to be discussed. The commons dilemma game lasts approximately 100 trials, that is the group members will be asked to play a card about 100 times. Now remember that in front of you is your player record sheet. When the game manager states what trial it is and asks you to play, you are to record what color you intend to play before you play it. That is, after you have recorded your play, point to the color you have recorded. Then, the game manager will walk around the table and record the play of the group. When the game manager has tallied the play of the group, he will announce the number of each card played and the number of points each colored card earned. Record the number of points you earned or lost on that trial. Also, you are to use the shields in front of you to conceal your play from the others you are playing with.

Finally, I would like to give you an analogy that may help you play this game. (The game manager will read this analogy word for word from a card.)

> It will be useful in the understanding of this game to look at points as a resource somewhat akin to the whales or fish in the ocean. If you try to get as many fish as possible each time you harvest, you will quickly deplete the resource--you will take the fish faster than they can reproduce and replace what you have harvested. If, however, you harvest at a moderate rate, the fish will be able to reproduce at a rate greater than or equal to the demand and the resource will last indefinitely. In summary, points,like the fish, reproduce every so often and if you are moderate in your take, the point resource should be rich and last the life of the game.

You are now ready to play the game and this is how each trial will work. I will announce the the trial, the trial number, and ask you to play. At this time, I want you to write in the color of the card you intend to play next to the trial number I announce. Then point to the card. Use the shields that have been provided to conceal your choices from the other players in the room. I will then walk around the room and tally what the group has played as a whole and then announce how many of each color was played. Finally, I will announce how many points each color earned or lost. Write in your record sheet next to the color you wrote, how many points you earned on that trial. Then we will move on to the next trial.

Now, until the game manager indicates differently, you are not to communicate with the other members of your group. Are you ready? Let's have a practice trial. Don't record what you are going to play or what the game manager announces as point values. O.K., Practice Trial, play. (Game manager walks around the room, records the group play, and announces the points each color would have earned if it had been a game trail.)

Are there any questions? (Game manager fields all questions relevant to the stated rules clarifying by paraphrasing the instructions.)

Standardized instructions for the generalization test

Fill in the information requested at the top of this sheet. At the bottom of the sheet in front of you is written: "I have played this game:" and "Check one:". Put an X in the box under "once".

Now, before you fill in one of the choices that will be required of you, there are some further instructions. I would like you all to understand who you are playing this game with. You are playing with all the people who have the same form, and the same gaming experience as you, past, present, and future.

No game-no fine. That is, you are playing with all the people this quarter who will or have come in here, sit down, and fill out this game sheet choosing either the red, the green and yellow choices. All the groups with your experience have had 10 minutes to discuss the chioces that they might make.

No game-fine. That is, you are playing with all the people this quarter who have or will come in here , sit down and fill out this game sheet, choosing either the red, the green, the yellow, or the black choice. In addition, all the groups with your experience will have had 10 minutes to discuss the choices that they might make.

Game no-fine. That is, you are playing with all the people this quarter who have or will come in here, sit down at this table, play the Commons Dilemma Game, and fill out this form, choosing either the red, the green, or the yellow choice. In addition, all the groups with your experience have had 10 minutes to discuss the choices that you might make.

Game-fine. That is, you are playing with all the people this quarter who have or will come in here; sit down at this table; play the Commons Dilemma Game; and fill out this form, choosing either the red, the green, the yellow, or the black choice. In addition, all the groups with your experience have had 10 minutes to discuss the choices that they might make.

Are there any questions about who you are playing with? (Game manager fields questions and makes sure the subjects understand who they are playing the form with. At this time subjects were also informed that the given group is in one of four conditions in an experiment and that they will be playing with approximately three or four other groups in the same condition.)

Now, before you make one of the choices, let me restate some of what is written on the sheet. If all of you play red, you will all earn 12 class points. However, if all of you play red and one person plays green, the red will earn 10 class points and the green will earn 20 class points. If all but two of you play red and those two both play green, then the reds will earn 8 class points and the green will earn 16 class points. If four or more people play green, persons who play red will earn one class point and the people who played green will earn two class points.

Also available as a choice is yellow. Yellow will give you three class points no matter what anyone else does. If you play yellow you will automatically earn 3 class points.

Fine option. The last choice available is black. It costs you nothing to play and it fines every player of green 3 class points.

If you like you may have up to 10 minutes to discuss among yourselves what you would like to do. When each of you have decided for yourself, mark one of the choices in private, and fold the sheet in half.

Standardized instructions for the small group posttest

This form is exactly like the other one you just completed except that you will only be playing with the seven people in this room. Again, you may have up to 10 minutes to discuss what you would like to do before you make your choice. When you have decided, mark one of the choices and fold your sheet in half.

(After the subjects have all made one of the choices on the small group posttest, they were informed of the results of the group on that posttest and told that the experiment was over.)

Appendix V

Table 4

Posttest Choices Given Pretest Choices for the Game-No Game Condition

Posttest Choices	Condition	Red f	Red p	Green f	Green p	Yellow f	Yellow p	Row Totals
		Choice on Pretest						
Red	Game	44	57.1	20	47.6	10	41.7	74
	No game	51	83.6	32	74.4	18	78.3	101
Green	Game	6	7.8	6	14.3	1	4.2	13
	No game	3	4.9	8	18.6	4	17.4	15
Yellow	Game	26	33.8	15	35.7	11	45.8	52
	No game	7	11.5	3	7.0	0	0.0	10
Black	Game	1	1.3	1	2.4	2	8.3	4
	No game	0	0.0	0	0.0	1	4.4	1
Totals	Game	77		42		24		143
	No game	61		43		23		127
	Both	138		85		47		270

Note. The letters 'f' and 'p' indicate the frequency and per cent of posttest choices given a pretest choice.

Table 5

Posttest Choices Given Pretest Choices for Fine-No Fine Condition

		Choice on Pretest						
		Red		Green		Yellow		
Posttest Choices	Condition	f	p	f	p	f	p	Row Totals
Red	Fine	46	65.7	20	66.7	16	64.0	82
	No fine	49	72.1	32	58.2	12	54.6	93
Green	Fine	6	8.6	2	6.7	2	18.0	10
	No fine	3	4.4	12	21.8	3	13.6	18
Yellow	Fine	17	24.3	7	23.3	4	16.0	28
	No fine	16	23.5	11	20.0	7	31.8	34
Black	Fine	1	1.4	1	3.3	3	12.0	5
	No fine	*		*		*		*
Totals	Fine	70		30		25		125
	No fine	68		55		22		145
	Both	138		85		47		270

Note. The letters 'f' and 'p' indicate the frequency and per cent of posttest choices given a pretest choice. Asterisks '*' indicate that this option was not available.

Table 6

Posttest Choices Given Pretest Choices across the Game-No Game Condition within the Fine Group

		Choice on Pretest						
		Red		Green		Yellow		
Posttest Choices	Condition	f	p	f	p	f	p	Row Totals
Red	Game	22	55.0	7	50.0	5	41.7	34
	No game	24	80.0	13	81.3	11	84.6	48
Green	Game	4	10.0	0	0.0	1	8.3	5
	No game	2	6.7	2	12.5	1	7.7	5
Yellow	Game	13	32.5	6	42.9	4	33.3	23
	No game	4	13.3	1	6.3	0	0.0	5
Black	Game	1	2.5	1	7.1	2	16.7	4
	No game	0	0.0	0	0.0	1	7.7	1
Totals	Game	40		14		12		66
	No game	30		16		13		59
	Both	70		30		25		125

Note. The letters 'f' and 'p' indicate the frequency and per cent of posttest choices given a pretest choice.

Table 7

Posttest Choices Given Pretest Choices for the Game-No Game Condition within the No Fine Group

Posttest Choices	Condition	Red f	Red p	Green f	Green p	Yellow f	Yellow p	Row Totals
		Choice on Pretest						
Red	Game	22	59.5	13	46.4	5	41.7	40
	No game	27	87.1	19	70.4	7	70.0	53
Green	Game	2	5.4	6	21.4	0	0.0	8
	No game	1	3.2	6	22.2	3	30.0	10
Yellow	Game	13	35.1	9	32.1	7	58.3	29
	No game	3	9.7	2	7.4	0	0.0	5
Black	Game	*		*		*		*
	No game	*		*		*		*
Totals	Game	37		28		12		77
	No game	31		27		10		68
	Both	68		55		22		145

Note. The letters 'f' and 'p' indicate the frequency and per cent of posttest choices given a pretest choice. Asterisks '*' indicate that this option is not available.